

HORTICULTURE FOR HOME GARDENS: PHYTOPHTHORA ROOT ROT

What Is Phytophthora?

Phytophthora (pronounced fy-TOF-thor-a) is a genus of pathogenic fungus-like organisms that infect plants, especially roots, causing root rot. Phytophthora is a type of water mold, growing best in an environment of free water in the soil or on foliage. The name Phytophthora means 'the plant destroyer'. Phytophthora is arguably the most destructive plant pathogen in the world, being the most serious disease of numerous agricultural crops and landscape plants. The cost of damage to crops caused by Phytophthora species in the United States alone runs into billions of dollars every year.

The most infamous species of Phytophthora is *P. infestans*, which causes late blight of potato and tomato. Late blight of potato is the disease that totally destroyed Ireland's potato crop in 1845 and 1846, resulting in the Irish potato famine. At the time many people attributed the disease to the rainy weather and industrial pollution. It was not until 1876 that the causal agent of late blight was identified as *P. infestans* by the German scientist Anton de Bary. Over 60 species of Phytophthora have since been described.

Common phytophthora root rots include those of avocado, citrus, pine, pineapple, camellia, azalea, tomato, carrot, rhododendron, oak and many more. Some species of Phytophthora, such as *P. infestans*, can cause disease on only a few plant species, while others, such as *P. cinnamomi*, cause disease on more than 900 species of plants. Although most Phytophthora species cause root rot, many also cause diseases that affect leaves, branches, twigs, and fruit.

Symptoms of Root Rot

Plants in the early stages of phytophthora root rot show symptoms of drought and starvation because the damaged roots can no longer draw water from the soil. Trees and shrubs exhibit poor growth, thinning of the canopy, tip die-back, small leaves, cupping of the leaves, poor leaf color, wilting, bud drop, poor flower production and small fruit or no flowers or fruit. Shrubs will often die one stem or branch at a time. Young trees suffering from phytophthora root rot are usually stunted and tend to just sit for long-periods with no new growth. Phytophthora can move from the roots to the trunk causing cankers that bleed and exude gum. Trunk cankers can appear dark brown or black and be sunken or depressed. In the absence of controls infected plants usually die.

Usually the tips of the roots are infected and killed first. Healthy root systems have many white root tips, and the roots are plump and firm. The root systems of infected plants have very few or no white root tips. The small feeder roots that are infected by Phytophthora will be dead and dark brown or black. In some plant species, such as citrus, the infected roots will slip or sluff off leaving a thin white thread or strand, which is the center of the root. In other plant species, such as avocado, the feeder roots will turn black and become brittle. Large roots will develop dead, dark brown to black lesions. Infected strawberry roots show a red-colored core which is diagnostic of strawberry red stele root rot caused by *P. fragariae*.

Life Cycle

The vegetative body of Phytophthora is called the mycelium and is composed of microscopic tubes or filaments called hyphae. Phytophthora lives inside of the roots of its host as mycelium. Most Phytophthora species produce three different spores: oospores,

chlamydospores, and zoospores. These spores play different roles in the life cycle of Phytophthora. Oospores are sexual spores which serve two functions, long term survival and genetic diversity. They are thick-walled and can persist for many years in the soil. Being sexually produced, oospores provide for genetic diversity over time. Chlamydospores are asexual spores that are thick-walled and can also persist in the soil for many years. Both oospores and chlamydospores provide for long term survival in the absence of a susceptible host or during adverse environmental conditions. Oospores and chlamydospores are stimulated and germinate when a root grows in close proximity.

The swimming zoospores are the main source of new infections in the root system. The zoospores are produced in microscopic sacs (sporangia), which form on the outside of infected roots. Zoospores are released when the soil becomes saturated during irrigation or rain. They can swim for hours and are attracted to roots. When they arrive at a root they become spherical and develop a cell wall. At this stage the zoospore is called a cyst. Encysted zoospores germinate by growing a hypha (a germ tube), which can directly penetrate a root and start a new infection. After Phytophthora has entered the root, it releases enzymes that break down the interior root cells. The degraded cells are utilized by Phytophthora for food. If the host dies or the environment changes, Phytophthora can produce oospores or chlamydospores or both.

Control

Limiting the frequency of irrigation is the most important means of controlling phytophthora root rot. When the soil becomes saturated during irrigation or rain, the zoospores are released. They swim to a root and start a new infection. Prolonged soil saturation caused by over watering, poor drainage or heavy rains leads to severe root rot. Watering less frequently limits the production of the zoospores that infect new roots and the number of infectious cycles that occur. Improving soil drainage will also help control phytophthora root rot. This can be accomplished by amending the soil with mulch, breaking up hardpans or by planting on raised mounds. High levels of organic matter and calcium in the soil can create an environment which suppresses phytophthora root rot.

Phytophthora can also be controlled with several different fungicides, such as Subdue® or Aliette®. Subdue® is applied as a root drench and has a residual activity of 90 days in the soil. It can be applied up to four times per year. Although it is not a restricted fungicide, Subdue® is not marketed to homeowners through nurseries. Homeowners can purchase Subdue® from a limited number of landscape contractor suppliers. Aliette® is a wettable powder that is applied as a spray to the foliage or as a root drench. The unique aspect of this fungicide is that it moves from the shoots to the roots. This allows for application to the leaves to control phytophthora root rot. Aliette® is now available from a limited number of nurseries for homeowner use. The best times to treat with either of these two fungicides is in the spring when new roots are being produced and in late fall prior to the seasonal rains. Carefully read the label, follow the application rates recommended, and wear protective clothing when applying these or any pesticides.

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